

## Intermediate workpiece supporting in crankshaft or camshaft milling

Publication number: GB2070489

Publication date: 1981-09-09

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Classification:

- international: B23B5/18; B23B31/16; B23Q1/76; B23B5/00;  
B23B31/12; B23Q1/00; (IPC1-7): B23B5/18

- european: B23B5/18; B23B31/16M; B23Q1/76B

Application number: GB19810003212 19810203

Priority number(s): AT19800001066 19800227; AT19800001526 19800321

Also published as:



FR2476518 (A1)

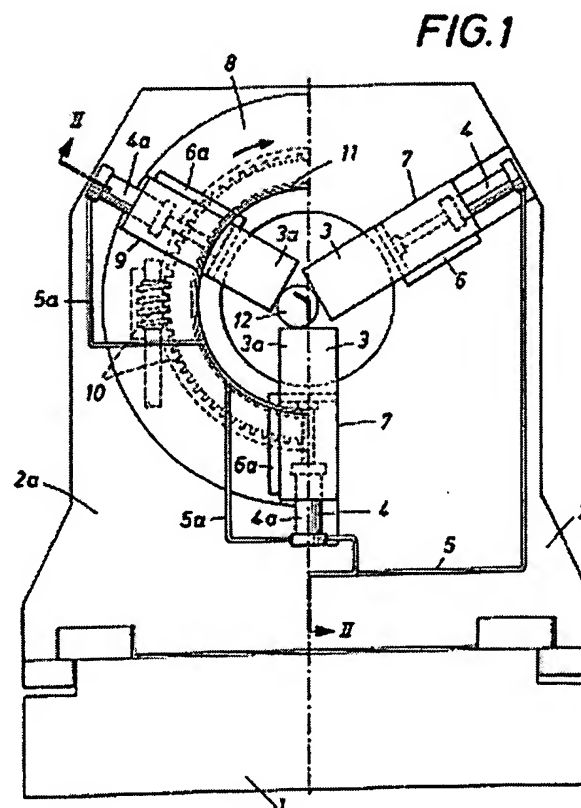
DE3101924 (A1)

DD156581 (B)

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### Abstract of GB2070489

During milling of crankshafts or camshafts, the workpiece 12 is gripped at both ends and is supported at at least one intermediate point. To eliminate the need for a straightening operation after milling and to minimize the grinding allowances for any subsequent grinding, the shaft is gripped at the intermediate point in the position which it actually assumes without centring. Each cylindrical portion of the shaft is machined while the shaft is gripped in such position. Hydraulically actuated jaws 3, 3a grip the workpiece and are coupled by a common hydraulic circuit 5, 5a. The jaws 3 can hold a stationary workpiece, or the jaws 3a are on a rotary ring 8 for workpiece rotation. The jaws are clamped 6, 6a in position.



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# (12) UK Patent Application (19) GB (11) 2 070 489 A

(21) Application No 8103212

(22) Date of filing 3 Feb 1981

(30) Priority data

(31) 1066/80

1526/80

(32) 27 Feb 1980

21 Mar 1980

(33) Austria (AT)

(43) Application published

9 Sep 1981

(51) INT CL<sup>3</sup>

B23B 5/18

(52) Domestic classification

B3T 4A17 4A21C 4A3E3

4A7 4B31DX

(56) Documents cited

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GB 733315

(58) Field of search

B3D

B3T

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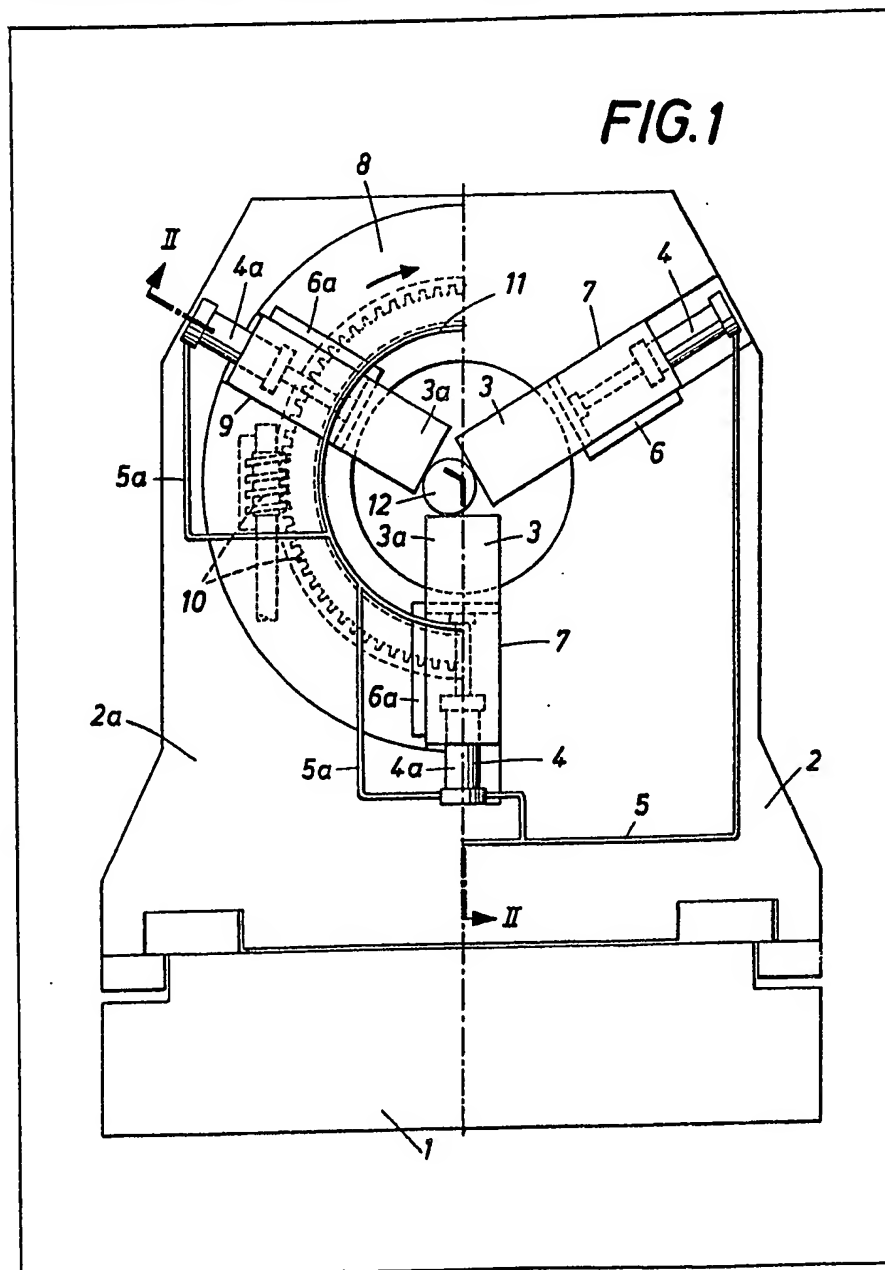
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(54) Intermediate workpiece  
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FIG. 1

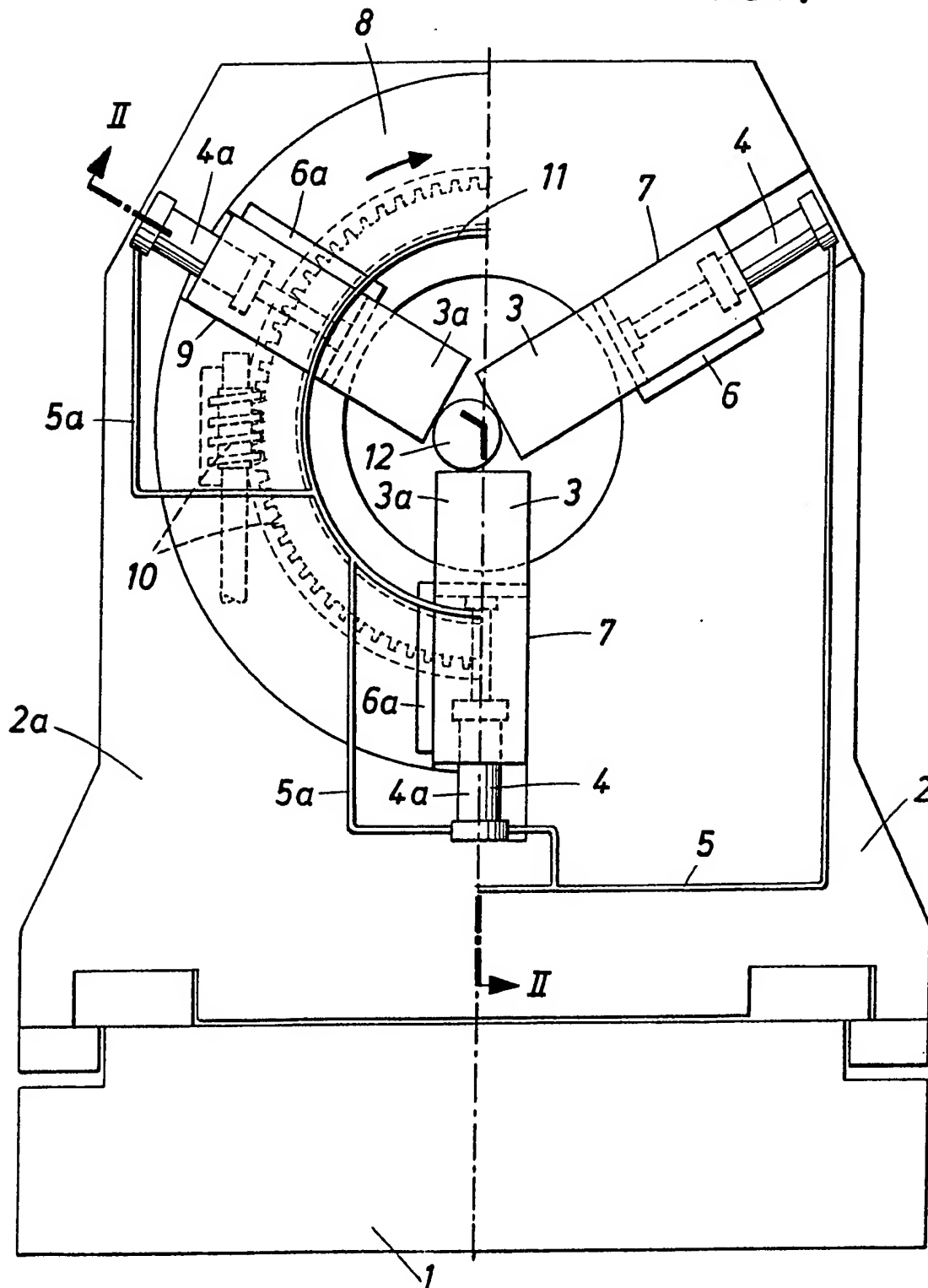
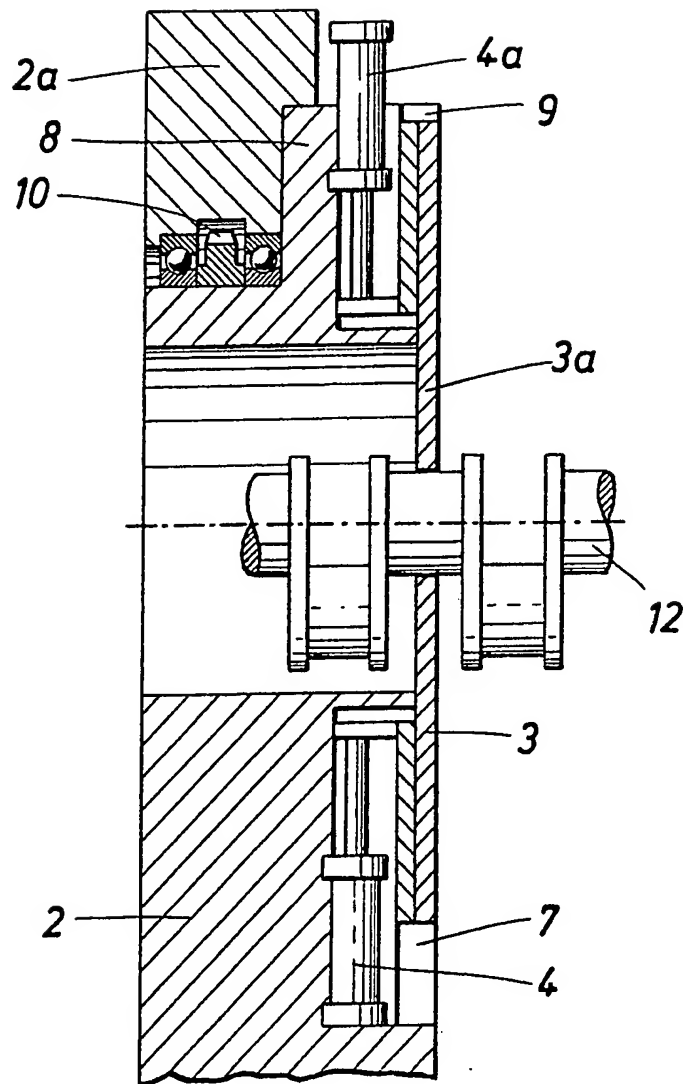


FIG. 2



## SPECIFICATION

## Process of milling crankshafts or camshafts

This invention relates to a process of milling crankshafts or camshafts wherein the workpiece is gripped at both ends and is supported at least at one intermediate point, while it is machined at a cylindrical portion, and a backrest for a milling machine for carrying out that process.

Crankshafts and camshafts are presently milled with a milling machine having one or two tool carriages and the workpiece to be machined is supported by a single or double backrest as close as possible to the point where machining is being carried out so that good cutting conditions and a machining with high accuracy are achieved. In a conventional machining process the milling of the cylindrical portions, e.g., the mainshaft portions and crankpins of a crankshaft, proceeds from one end to the other and the mainshaft portion which has just been milled is supported during the machining of the following cylindrical portions. Self-centering backrests have previously been employed to support the mainshaft portions so that the mainshaft portions are not only supported but are moved to and held in a centered position. As a result, even when the workpiece has been deflected during the machining as a result of a release of internal stresses, the workpiece will be straightened for each machining step so that it is ensured that the crankpins will be in the proper position relative to the mainshaft portion within a corresponding tolerance range. That machining process has the disadvantage that when the milling of the workpiece has been completed it will spring back to its deflected shape and the resulting deflection can be eliminated only by a special straightening step, which is highly expensive because it cannot be automatically controlled, or by a grinding step, which requires very large grinding allowances.

It is an object of the invention to eliminate these disadvantages and to provide a process which is of the kind described first hereinbefore and which eliminates the need for a straightening step after the milling operation and which greatly reduces the grinding allowances for any grinding operation which may still be required. Besides, it is desired to provide a backrest for a milling machine for efficiently carrying out that process.

This object is accomplished according to the invention in that the shaft when gripped at both ends is additionally gripped at an intermediate point in the position which it actually assumes and without being centered and each cylindrical portion of the shaft is machined while the shaft is gripped in such position. Because the shaft is simply gripped at the point at which it is supported and is not straightened or centered as it is supported, the workpiece which has been finished cannot spring back to a deflected shape but will remain in the shape which has resulted from the machining. As a result, at least those cylindrical portions which were not supported will be exactly

axis of the workpiece when the latter has been machined because these cylindrical portions will be milled by the tool like those of a perfectly centered shaft and this will eliminate also the deflections which are due to the release of internal stresses. When the workpiece is supported at its mainshaft portions in the usual manner during the milling operation and all mainshaft portions are machined first, followed by the crankpins, the mainshaft portions will remain eccentric but in that case a grinding allowance will be required only at the mainshaft portions. On the other hand, when mainshaft portions as well as crankpins are machined while the shaft is supported at a mainshaft portion, the conditions relating to these mainshaft portions being machined will be similar to those for the crankpins so that the deflections that have occurred at the mainshaft portions prior to that machining will be removed by milling and the completely milled shaft will have only relatively small deflections. Only those deflections must be eliminated after the milling operation because there is no springback so that other eccentricities can no longer occur. Those slight deflections can be eliminated without difficulty. Because the process according to the invention comprises no centering, the shaft need not always be supported at a mainshaft portion but may be supported at a crankpin or even at a crankweb. The points at which the shaft is to be supported can be selected in dependence on the conditions for machining and in this way the deflections which may have to be eliminated when the shaft has been milled can be influenced as to their extent and to the quantity of material to be removed.

The process according to the invention is not restricted to a specific milling sequence but may be applied to the milling of crankshafts and camshafts in various sequences, for instance, to a stepwise milling of the shaft at only one cylindrical portion at a time or of two cylindrical portions at a time, to operations in which the shaft is supported only at one section at a time or at two sections at the same time or in which the shaft is always supported at the middle of its length or in which the point of support proceeds, to milling operations comprising roughing and finishing steps or to milling operations comprising only a finishing step. In most cases the application of the process will be restricted to short shafts, i.e., to crankshafts and camshafts for engines for passenger cars and trucks, because the process makes no allowance for the fact that the workpiece will sag under its own weight as that sag is not significant with short shafts.

Because the shaft is supported without being centered, the process according to the invention permits also a supporting of the shaft at portions which have not been machined so that expensive preparatory operations, such as the turning of an annular band for engaging a backrest, will not be required. Besides, this fact provides more latitude regarding the association of points of support and

The process can be carried out in a simple manner if, according to a further feature of the invention, a backrest is used in a suitable milling machine and comprises at least two gripping jaws, which are adapted to be moved by positioning drives into engagement with the portions to be supported, regardless of the position of the workpiece, and are adapted to have pressure jointly applied to them when they have engaged the workpiece, wherein clamping devices are associated with the gripping jaws and adapted to clamp them in any desired position independently of each other. Because the shaft is gripped without being centered, it must be possible to engage each gripping jaw independently of the other with the workpiece and the clamping pressure required must not be applied until all gripping jaws engage the workpiece.

The positioning drives, which can move the gripping jaws independently of each other and when the latter have engaged the workpiece permit a joint gripping action of the gripping jaws, consist, preferably of special hydraulic or pneumatic actuators, which communicate with each other or are connected to a common pressure fluid source. Where such hydraulic or pneumatic actuators are used, the desired positioning can be effected without need for a high structural expenditure. The supporting of the workpiece will be greatly facilitated by the clamping devices because they can hold the gripping jaws in the supporting position to which they have been relieved.

To ensure that the process according to the invention can also be carried out when the workpiece is rotated as it is milled, the gripping jaws, the positioning drives and the clamping devices may be mounted in a rotatably mounted carrying ring, which surrounds the workpiece. In that case the shaft can be supported at the point of support and can be eccentrically supported at that point, if desired, and in spite of that support can be rotated while the cylindrical portions are being milled. This is so because the carrying ring permits the gripping jaws to revolve with the workpiece. If the carrying ring is adapted to be selectively fixed in position, the backrest can be used for a milling of stationary or driven shafts.

A backrest provided according to the invention for a milling machine is strictly diagrammatically shown on the accompanying drawings, in which

Figure 1 is an end view showing on its left-hand half a backrest for a milling machine for machining a rotating workpiece and on its right-hand half a backrest for a milling machine for machining a stationary workpiece, and

Figure 2 is an axial sectional view taken on line II—II in Figure 1 through both illustrative embodiments.

Each of the backrests 2 and 2a is slidable along the bed 1 of a milling machine not shown in detail and is provided with three radially adjustable gripping jaws 3 or 3a, each of which is displaceable by an associated hydraulic actuator 4 or 4a. The hydraulic actuators 4 or 4a

communicate with each other by conduits 5 or 5a and are jointly supplied with pressure fluid. Clamping devices 6 or 6a, which may be hydraulically or mechanically actuated, are provided to fix the respective gripping jaws 3 or 3a in any desired position.

For use in a milling machine for machining a stationary workpiece each gripping jaw 3 is directly mounted in a guide 7, which is fixed to the backrest, and each gripping jaw 3 is simply radially adjusted by the associated hydraulic actuator 4 (right-hand half of Figure 1 and lower half of Figure 2). In a milling machine for machining rotating workpieces, the gripping jaws 3a must be capable of moving in unison with the workpiece (left-hand half of Figure 1 and upper half of Figure 2). For this purpose the gripping jaws 3a, the hydraulic actuators 4a and the clamping means 6a are mounted in a carrying ring 8 and each gripping jaw 3a is radially adjustably mounted in a guide 9, which is fixed to the carrying ring. The carrying ring 8 surrounds the workpiece to be machined and is rotatably mounted in the backrest 2a. A transmission 10 ensures that the carrying ring 8 will be driven in synchronism with the rotation of the workpiece so that the supporting means will revolve in unison with the workpiece as the latter is machined. For a supply of pressure fluid to the hydraulic actuators 4a, the conduits 5a open into an annular conduit 11 of the carrying ring 8. That annular conduit is connected by means not shown to a pressure fluid source accommodated in the carrying ring or via a rotary loadthrough to a pressure fluid source disposed outside the carrying ring.

The backrest 2 or 2a with the properly adjustable gripping jaws 3 or 3a can be used to grip a workpiece 12 without centering the same so that the workpiece can be fixed also in an eccentric position. For this reason, a crankshaft or camshaft to be milled can be supported in the position actually assumed by the shaft so that the shaft will not spring back to a deflected position when its milling has been completed.

## 110 CLAIMS

1. A process of milling crankshafts or camshafts wherein the workpiece is gripped at both ends and is supported at at least one intermediate point while it is machined at a cylindrical portion, characterized in that the shaft when gripped at both ends is additionally gripped at an intermediate point in the position which it actually assumes and without being centered and each cylindrical portion of the shaft is machined while the shaft is gripped in such position.

2. A process according to claim 1, characterized in that the shaft is fixed in its existing position by being supported at at least one of its mainshaft portions.

3. A backrest for use in a milling machine for carrying out a process according to claim 1 or 2, comprising at least two gripping jaws, which are adapted to be moved by positioning drives into engagement with the portions to be supported

regardless of the position of the workpiece, and  
are adapted to have pressure jointly applied to  
them when they have engaged the workpiece,  
characterized in that clamping devices are  
5 associated with the gripping jaws and adapted to  
clamp them in any desired position independently

of each other.

4. A backrest according to claim 3,  
characterized in that the gripping jaws, the  
10 positioning drives and the clamping devices are  
mounted in a rotatably mounted carrying ring,  
which surrounds the workpiece.